

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-105499

(43)Date of publication of application : 17.04.2001

(51)Int.Cl.

B29C 65/16
B23K 26/00

(21)Application number : 11-285637

(71)Applicant : TOYOTA MOTOR CORP

(22)Date of filing : 06.10.1999

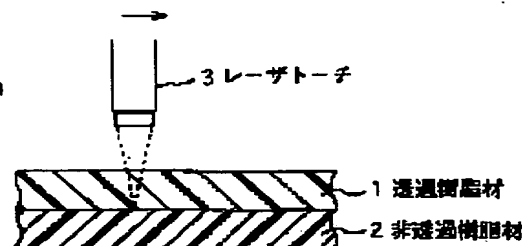
(72)Inventor : NAKAMURA HIDEO

(54) LASER WELDING METHOD FOR RESIN MATERIAL

(57)Abstract:

PROBLEM TO BE SOLVED: To control the energy loss of laser beams when the laser beams are transmitted inside a transmitting resin material and achieve the sufficient welding strength.

SOLUTION: A transmitting resin material 1 having laser beams as a heat source and a non-transmitting resin material 2 not having transmittance for the laser beams are overlapped together, and then the laser beams are emitted from the side of the transmitting resin material to heat weld the joining face of the transmitting resin material 1 with the non-transmitting resin material 2 and join integrally both. At that time, the laser beams having the wavelength providing the 26% or more transmittance in the transmitting resin material 1 is used as a heat source. Thus the energy loss of the laser beams transmitted in the transmitting resin material 1 is reduced to generate sufficient heat melting on the joining surface and achieve to obtain the sufficient strength.



LEGAL STATUS

[Date of request for examination]

16.05.2002

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

3630293

[Date of registration]

24.12.2004

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

Copyright (C); 1998,2003 Japan Patent Office

*** NOTICES ***

JPO and NCIP are not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] After piling up the transparency resin material which is penetrable to the laser beam as a source of heating, and the nontransparent resin material which is opaque to this laser beam, by irradiating this laser beam from this transparency resin material side The laser joining approach of the resin material characterized by using the laser beam which has wavelength from which the permeability in the above-mentioned transparency resin material becomes 26% or more in the laser joining approach of the resin material which is made to carry out heating melting of the plane of composition of this transparency resin material and this nontransparent resin material, and joins both in one as a source of heating.

[Translation done.]

*** NOTICES ***

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.*** shows the word which can not be translated.

3.In the drawings, any words are not translated.

DETAILED DESCRIPTION**[Detailed Description of the Invention]**

[0001]

[Field of the Invention] This invention carries out heating melting of the plane of composition of the piled-up resin material by the laser beam as a source of joining heating in detail about the laser joining approach of resin material, and relates to the laser joining approach of the resin material which joins both in one.

[0002]

[Description of the Prior Art] As the junction approach of resin material, the laser joining approach is used conventionally. For example, after laying the transparency resin material which is penetrable to a laser beam, and the nontransparent resin material which is opaque to this laser beam on top of JP,60-214931,A, the laser joining approach which is made to carry out heating melting of the plane of composition of transparency resin material and nontransparent resin material, and joins both in one is indicated by irradiating a laser beam from this transparency resin material side.

[0003] By this laser joining approach, the laser beam which penetrated the inside of transparency resin material arrived at the plane of composition of nontransparent resin material, was absorbed, and was absorbed by this plane of composition is accumulated as energy. Consequently, while heating melting of the plane of composition of nontransparent resin material is carried out, heating melting of the plane of composition of transparency resin material is carried out by heat transfer from the plane of composition of this nontransparent resin material. In this condition, if the plane of composition of transparency resin material and the planes of composition of nontransparent resin material are made to stick by pressure, both are joinable in one.

[0004]

[Problem(s) to be Solved by the Invention] However, by the above-mentioned conventional laser joining approach, if the energy loss of the laser beam at the time of penetrating the inside of transparency resin material is large, heating melting in the plane of composition of nontransparent resin material and transparency resin material becomes inadequate, and there is a problem that sufficient joining reinforcement cannot be attained.

[0005] This invention is made in view of the above-mentioned actual condition, and the energy loss of the laser beam at the time of penetrating the inside of transparency resin material is suppressed, and let it be the technical technical problem which should be solved to offer the laser joining approach of the resin material which can attain sufficient joining reinforcement.

[0006]

[Means for Solving the Problem] The laser joining approach of the resin material of this invention which solves the above-mentioned technical problem After piling up the transparency resin material which is penetrable to the laser beam as a source of heating, and the nontransparent resin material which is opaque to this laser beam, by irradiating this laser beam from this transparency resin material side The laser joining approach of the resin material characterized by using the laser beam which has wavelength from which the permeability in the above-mentioned transparency resin material becomes 26% or more in the laser joining approach of the resin material which is made to carry out heating melting of the plane of composition of this transparency resin material and this nontransparent resin material, and joins both in one as a source of heating.

[0007]

[Embodiment of the Invention] By the laser joining approach of the resin material of this invention, a laser beam is irradiated to the transparency resin material which is penetrable to the laser beam as a source of heating, and the nontransparent resin material which is opaque to this laser beam from this superposition

and transparency resin material side. The laser beam irradiated from the transparency resin material side penetrates the inside of this transparency resin material, arrives at the plane of composition of nontransparent resin material, and is absorbed. As a result of accumulating as energy the laser beam absorbed by the plane of composition of this nontransparent resin material, while heating melting of the plane of composition of nontransparent resin material is carried out, heating melting of the plane of composition of transparency resin material is carried out by heat transfer from the plane of composition of this nontransparent resin material. In this condition, if the plane of composition of transparency resin material and the planes of composition of nontransparent resin material are made to stick by pressure, both are joinable in one.

[0008] And by this invention approach, the laser beam which has wavelength from which the permeability in transparency resin material becomes 26% or more is used as a source of heating. For this reason, the energy loss of the laser beam which the laser beam irradiated from the transparency resin material side fully penetrates the inside of this transparency resin material, and penetrates the inside of transparency resin material is reduced. Therefore, sufficient energy to carry out heating melting of the plane of composition of transparency resin material and nontransparent resin material is accumulated in this plane of composition, as a result, heating melting sufficient in this plane of composition happens, and it becomes possible to attain sufficient joining reinforcement.

[0009] It will not be limited, especially if have thermoplasticity, the laser beam as a source of heating is made to penetrate above predetermined permeability and it gets as a class of the above-mentioned transparency resin material. For example, polyamides (PA), such as nylon 6 (PA6), nylon 6, and 6 (PA66), polyethylene (PE), polypropylene (PP), a styrene acrylonitrile copolymer, etc. can be mentioned. In addition, what was strengthened with the glass fiber etc., and the colored thing may be used if needed.

[0010] As a class of the above-mentioned nontransparent resin material, it has thermoplasticity, and especially if it may absorb without making the laser beam as a source of heating penetrate, it will not be limited. For example, what mixed predetermined coloring agents, such as carbon black, in polyamides (PA), such as nylon 6 (PA6), nylon 6, and 6 (PA66), polyethylene (PE), polypropylene (PP), a styrene acrylonitrile copolymer, etc. can be mentioned. In addition, what was strengthened with the glass fiber etc. may be used if needed.

[0011] As a class of laser beam used as a source of heating, it is relation with an absorption spectrum of transparency resin material, board thickness (transparency length), etc. which make a laser beam penetrate, and what has wavelength from which the permeability within transparency resin material becomes 26% or more is selected suitably. for example, a glass fiber -- 30wt(s)% -- since the permeability within this transparency resin material will become 26% or more if the wavelength of a laser beam is about 1.5-2.5 micrometers when it contains and the nylon 6 whose board thickness is about 1-5mm is used as transparency resin material, various semiconductor laser, HF chemical laser, etc. which have the wavelength of this within the limits can be used.

[0012] In addition, exposure conditions, such as an output of laser and working speed (passing speed), can be suitably set up according to the class of transparency resin material and nontransparent resin material etc.

[0013]

[Example] Hereafter, an example explains this invention concretely.

[0014] a glass fiber -- 30wt(s)% -- it consisted of nylon 6 added and strengthened, and the transparency resin material 1 of 3mm of board thickness which is penetrable to the laser beam as a source of heating, and the nontransparent resin material 2 of 3mm of board thickness which carbon black consists of nylon 6 by which specified quantity addition was carried out, and is opaque to the laser beam as a source of heating were prepared. The laser torch 3 which, on the other hand, emits the YAG:Nd3+ laser beam whose wavelength is 1.06 micrometers was prepared.

[0015] And as shown in drawing 1, while piling up the transparency resin material 1 on the nontransparent resin material 2, it clamped with a clamp means by which the transparency resin material 1 and the nontransparent resin material 2 are not illustrated. In this condition, the laser torch 3 was irradiated from the transparency resin material 1 side, and the transparency resin material 1 and the nontransparent resin material 2 were joined in one by laser joining. In addition, the output of laser was made to 400W and working speed was made into 4 m/min.

[0016] It was 40% when the permeability at the time of the laser beam emitted from the above-mentioned laser torch 3 penetrating the transparency resin material 1 was measured. Moreover, it was 50MPa when the joining reinforcement of the transparency resin material 1 and the nontransparent resin material 2 was measured.

[0017] In addition, permeability was measured by computing incidence energy by work-piece existence, and joining reinforcement measured the welding by carrying out tension fracture.

[0018] (Relation between the permeability of laser, and joining reinforcement) In the above-mentioned example, by adding the color as a coloring agent to the transparency resin material 1, and changing various the addition, various permeability of the laser beam in the transparency resin material 1 was changed, and the relation of the permeability of a laser beam and joining reinforcement in the transparency resin material 1 was investigated. The result is shown in drawing 2 .

[0019] If the permeability of the laser beam in the transparency resin material 1 is 26% or more so that clearly from drawing 2 , it turns out that joining reinforcement is set to 45 or more MPas, and sufficient joining reinforcement can be attained.

[0020] (Relation between the wavelength of a laser beam, and permeability) a glass fiber -- 30wt(s)% -- the relation between the permeability of the laser beam in the transparency resin material 1 which consists of added nylon 6, and the wavelength of a laser beam was investigated about each transparency resin material (1mm of board thickness, 3mm, and 5mm) 1. The result is shown in drawing 3 .

[0021] Even if it was about 1.5-2.5 micrometers, then 5mm and the thick transparency resin material 1, the permeability of a laser beam became 26% or more about the wavelength of a laser beam, so that clearly from drawing 3 . On the other hand, when wavelength was the YAG:Nd3+ laser which is 1.06 micrometers and the board thickness of the transparency resin material 1 became thick at 5mm or more, permeability became about 24% or less.

[0022] therefore, a glass fiber -- 30wt(s)% -- when it consisted of added nylon 6 and laser welding of the transparency resin material 1 of about 5mm or less of board thickness was carried out, it was checked in the permeability of the laser beam in the transparency resin material 1 by setting wavelength of a laser beam to about 1.5-2.5 micrometers that joining reinforcement sufficient as 26% or more can be attained.

[0023]

[Effect of the Invention] Since the energy loss of the laser beam which penetrates the inside of transparency resin material is reduced according to the laser joining approach of the resin material of this invention as explained in full detail above, heating melting sufficient in the plane of composition of transparency resin material and nontransparent resin material happens, and it becomes possible to attain sufficient joining reinforcement.

[Translation done.]

* NOTICES *

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

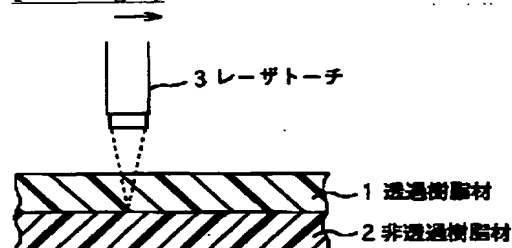
1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

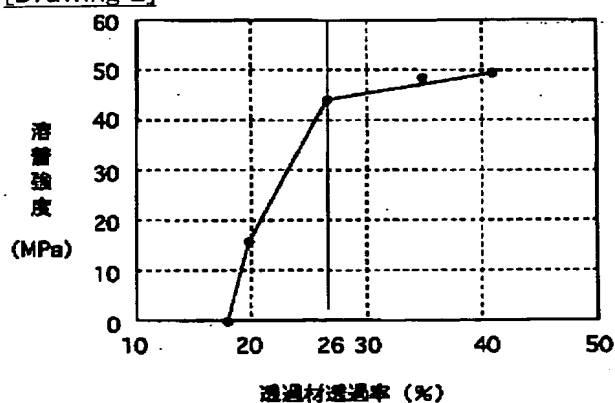
3.In the drawings, any words are not translated.

DRAWINGS

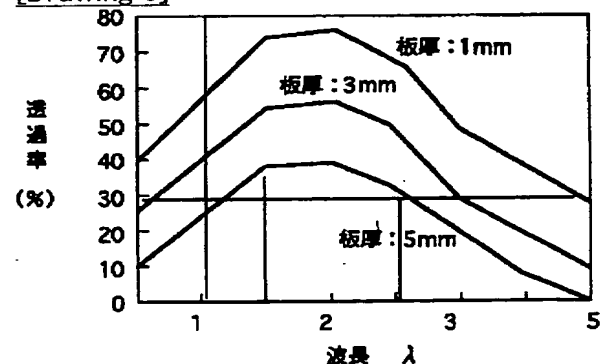
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]

(19)日本国特許庁 (J P)

(12) 公 開 特 許 公 報 (A)

(11)特許出願公開番号

特開2001-105499

(P2001-105499A)

(43)公開日 平成13年4月17日(2001.4.17)

(51)Int.Cl. ⁷	識別記号	F I	テームコード(参考)
B 2 9 C 65/16		B 2 9 C 65/16	4 E 0 6 8
B 2 3 K 26/00	3 1 0	B 2 3 K 26/00	3 1 0 S 4 F 2 1 1
			3 1 0 G

審査請求 未請求 請求項の数1 O L (全 4 頁)

(21)出願番号 特願平11-285637

(22)出願日 平成11年10月6日(1999.10.6)

(71)出願人 000003207

トヨタ自動車株式会社

愛知県豊田市トヨタ町1番地

(72)発明者 中村 秀生

愛知県豊田市トヨタ町1番地 トヨタ自動車株式会社内

(74)代理人 100081776

弁理士 大川 宏

Fターム(参考) 4E068 BF00 DB10

4F211 AA29 AD05 AD35 TA01 TC02

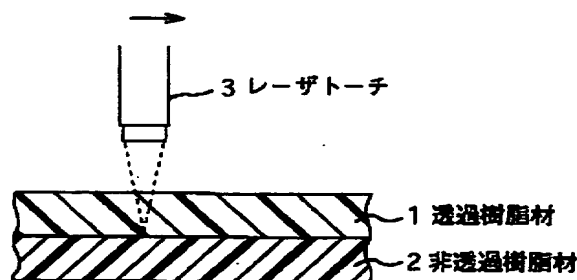
TD11 TJ30 TN27

(54)【発明の名称】 樹脂材のレーザー溶着方法

(57)【要約】

【課題】透過樹脂材内を透過する際のレーザー光のエネルギーロスを抑えて、十分な溶着強度を達成する。

【解決手段】加熱源としてのレーザー光に対して透過性のある透過樹脂材1と、レーザー光に対して透過性のない非透過樹脂材2とを重ね合わせた後、透過樹脂材側からレーザー光を照射することにより、透過樹脂材1と非透過樹脂材2との接合面を加熱溶融させて両者を一体的に接合する。この際、透過樹脂材1内の透過率が26%以上となるような波長を有するレーザー光を加熱源として用いる。これにより、透過樹脂材1内を透過するレーザー光のエネルギーロスが低減されるので、接合面で十分な加熱溶融が起こり、十分な溶着強度を達成することが可能となる。



【特許請求の範囲】

【請求項1】 加熱源としてのレーザ光に対して透過性のある透過樹脂材と、該レーザ光に対して透過性のない非透過樹脂材とを重ね合わせた後、該透過樹脂材側から該レーザ光を照射することにより、該透過樹脂材と該非透過樹脂材との接合面を加熱溶解させて両者を一体的に接合する樹脂材のレーザ溶着方法において、上記透過樹脂材内の透過率が26%以上となるような波長を有するレーザ光を加熱源として用いることを特徴とする樹脂材のレーザ溶着方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は樹脂材のレーザ溶着方法に関し、詳しくは、重ね合わせた樹脂材の接合面を溶着加熱源としてのレーザ光により加熱溶解させて、両者を一体的に接合する樹脂材のレーザ溶着方法に関する。

【0002】

【従来の技術】樹脂材同士の接合方法として、従来よりレーザ溶着方法が利用されている。例えば、特開昭60-214931号公報には、レーザ光に対して透過性のある透過樹脂材と、該レーザ光に対して透過性のない非透過樹脂材とを重ね合わせた後、該透過樹脂材側からレーザ光を照射することにより、透過樹脂材と非透過樹脂材との接合面を加熱溶解させて両者を一体的に接合するレーザ溶着方法が開示されている。

【0003】このレーザ溶着方法では、透過樹脂材内を透過したレーザ光が非透過樹脂材の接合面に到達して吸収され、この接合面に吸収されたレーザ光がエネルギーとして蓄積される。その結果、非透過樹脂材の接合面が加熱溶解されるとともに、この非透過樹脂材の接合面からの熱伝達により透過樹脂材の接合面が加熱溶解される。この状態で、透過樹脂材の接合面及び非透過樹脂材の接合同士を圧着させれば、両者を一体的に接合することができる。

【0004】

【発明が解決しようとする課題】しかしながら、上記従来のレーザ溶着方法では、透過樹脂材内を透過する際のレーザ光のエネルギーロスが大きければ、非透過樹脂材及び透過樹脂材の接合面における加熱溶解が不十分となり、十分な溶着強度を達成することができないという問題がある。

【0005】本発明は上記実情に鑑みてなされたものであり、透過樹脂材内を透過する際のレーザ光のエネルギーロスを抑えて、十分な溶着強度を達成することのできる樹脂材のレーザ溶着方法を提供することを解決すべき技術課題とするものである。

【0006】

【課題を解決するための手段】上記課題を解決する本発明の樹脂材のレーザ溶着方法は、加熱源としてのレーザ

光に対して透過性のある透過樹脂材と、該レーザ光に対して透過性のない非透過樹脂材とを重ね合わせた後、該透過樹脂材側から該レーザ光を照射することにより、該透過樹脂材と該非透過樹脂材との接合面を加熱溶解させて両者を一体的に接合する樹脂材のレーザ溶着方法において、上記透過樹脂材内の透過率が26%以上となるような波長を有するレーザ光を加熱源として用いることを特徴とする樹脂材のレーザ溶着方法。

【0007】

10 【発明の実施の形態】本発明の樹脂材のレーザ溶着方法では、加熱源としてのレーザ光に対して透過性のある透過樹脂材と、該レーザ光に対して透過性のない非透過樹脂材とを重ね合わせ、該透過樹脂材側からレーザ光を照射する。透過樹脂材側から照射されたレーザ光は該透過樹脂材内を透過して非透過樹脂材の接合面に到達し、吸収される。この非透過樹脂材の接合面に吸収されたレーザ光がエネルギーとして蓄積される結果、非透過樹脂材の接合面が加熱溶解されるとともに、この非透過樹脂材の接合面からの熱伝達により透過樹脂材の接合面が加熱溶解される。この状態で、透過樹脂材の接合面及び非透過樹脂材の接合同士を圧着させれば、両者を一体的に接合することができる。

20

【0008】そして、本発明方法では、透過樹脂材内の透過率が26%以上となるような波長を有するレーザ光を加熱源として用いる。このため、透過樹脂材側から照射されたレーザ光は該透過樹脂材内を十分に透過し、透過樹脂材内を透過するレーザ光のエネルギーロスが低減される。したがって、透過樹脂材及び非透過樹脂材の接合面を加熱溶解させるのに十分なエネルギーが該接合面に蓄積され、その結果該接合面で十分な加熱溶解が起こり、十分な溶着強度を達成することが可能となる。

30

【0009】上記透過樹脂材の種類としては、熱可塑性を有し、加熱源としてのレーザ光を所定の透過率以上で透過させるものであれば特に限定されない。例えば、ナイロン6(PA6)やナイロン6,6(PA66)等のポリアミド(PA)、ポリエチレン(PE)、ポリプロピレン(PP)やスチレン-アクリロニトリル共重合体等を挙げることができる。なお、必要に応じて、ガラス繊維等で強化したものや着色したものをを用いてもよい。

40

【0010】上記非透過樹脂材の種類としては、熱可塑性を有し、加熱源としてのレーザ光を透過させずに吸収しうるものであれば特に限定されない。例えば、ナイロン6(PA6)やナイロン6,6(PA66)等のポリアミド(PA)、ポリエチレン(PE)、ポリプロピレン(PP)やスチレン-アクリロニトリル共重合体等に、カーボンブラック等の所定の着色剤を混入したものを挙げることができる。なお、必要に応じて、ガラス繊維等で強化したものをを用いてもよい。

50

【0011】加熱源として用いるレーザ光の種類として

は、レーザ光を透過させる透過樹脂材の吸収スペクトルや板厚（透過長）等との関係で、透過樹脂材内での透過率が26%以上となるような波長を有するものが適宜選定される。例えば、ガラス繊維を30wt%含有し、板厚が1～5mm程度のナイロン6を透過樹脂材として用いた場合は、レーザ光の波長が1.5～2.5μm程度であれば、該透過樹脂材内での透過率が26%以上となるので、かかる範囲内の波長を有する種々の半導体レーザやHF化学レーザ等を用いることができる。

【0012】なお、レーザの出力や加工速度（移動速度）等の照射条件は、透過樹脂材及び非透過樹脂材の種類等に応じて適宜設定可能である。

【0013】

【実施例】以下、実施例により本発明を具体的に説明する。

【0014】ガラス繊維が30wt%添加されて強化されたナイロン6からなり、加熱源としてのレーザ光に対して透過性のある板厚3mmの透過樹脂材1と、カーボンブラックが所定量添加されたナイロン6からなり、加熱源としてのレーザ光に対して透過性のない板厚3mmの非透過樹脂材2とを準備した。一方、波長が1.06μmのYAG:Nd³⁺レーザ光を発するレーザトーチ3を準備した。

【0015】そして、図1に示すように、非透過樹脂材2の上に透過樹脂材1を重ね合わせるとともに、透過樹脂材1及び非透過樹脂材2を図示しないクランプ手段でクランプした。この状態で、レーザトーチ3を透過樹脂材1側から照射して、透過樹脂材1と非透過樹脂材2とをレーザ溶着により一体的に接合した。なお、レーザの出力は400W、加工速度は4m/minとした。

【0016】上記レーザトーチ3から発せられたレーザ光が透過樹脂材1を透過する際の透過率を測定したところ、40%であった。また、透過樹脂材1と非透過樹脂材2との溶着強度を測定したところ、50MPaであった。

【0017】なお、透過率は、入射エネルギーをワーク有無で算出することにより測定し、溶着強度は、溶着部を引張り破断することにより測定した。

【0018】（レーザの透過率と溶着強度との関係）上記実施例において、透過樹脂材1に着色剤としての染料を添加し、その添加量を種々変更することにより、透過

樹脂材1におけるレーザ光の透過率を種々変更して、透過樹脂材1におけるレーザ光の透過率と溶着強度との関係を調べた。その結果を図2に示す。

【0019】図2から明らかなように、透過樹脂材1におけるレーザ光の透過率が26%以上あれば、溶着強度が45MPa以上となり、十分な溶着強度を達成できることがわかる。

【0020】（レーザ光の波長と透過率との関係）ガラス繊維が30wt%添加されたナイロン6からなる透過樹脂材1におけるレーザ光の透過率と、レーザ光の波長との関係を、板厚1mm、3mm、5mmの各透過樹脂材1について調べた。その結果を図3に示す。

【0021】図3から明らかなように、レーザ光の波長を1.5～2.5μm程度とすれば、5mmと厚い透過樹脂材1であってもレーザ光の透過率が26%以上となった。これに対し、波長が1.06μmであるYAG:Nd³⁺レーザの場合、透過樹脂材1の板厚が5mm以上に厚くなると、透過率が24%程度以下になった。

【0022】したがって、ガラス繊維が30wt%添加されたナイロン6からなり、板厚5mm程度以下の透過樹脂材1をレーザ溶着する場合は、レーザ光の波長を1.5～2.5μm程度とすることにより、透過樹脂材1におけるレーザ光の透過率を26%以上として十分な溶着強度を達成できることが確認された。

【0023】

【発明の効果】以上詳述したように本発明の樹脂材のレーザ溶着方法によれば、透過樹脂材内を透過するレーザ光のエネルギーロスが低減されるので、透過樹脂材及び非透過樹脂材の接合面で十分な加熱溶融が起り、十分な溶着強度を達成することが可能となる。

【図面の簡単な説明】

【図1】本発明の一実施例に係り、樹脂材のレーザ溶着方法を説明する概略断面図である。

【図2】透過樹脂材におけるレーザ光の透過率と溶着強度との関係を示す線図である。

【図3】レーザ光の波長と透過樹脂材におけるレーザ光の透過率との関係を示す線図である。

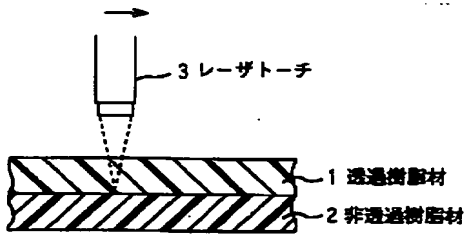
【符号の説明】

1…透過樹脂材

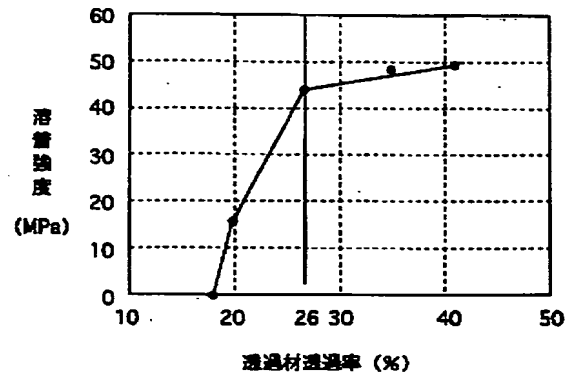
2…非透過樹脂材

3…レーザトーチ

【図1】



【図2】



【図3】

